

EPIDEMIOLOGY

Short Message Service (SMS) Technology in Alcohol Research—A Feasibility Study

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(Received 29 October 2008; accepted 8 May 2009; advance access publication 29 May 2009)

Abstract — Aim: The aim of this study was to describe the feasibility, advantages and limitations of the combined use of Internet and SMS technology to assess alcohol use, and to test whether an SMS sent in the evening (i.e. prior to a possible drinking event) changed the respondents' assessment, made on the following day, of the number of drinks consumed. **Participants:** Seventy young adults (mean age 22.7) were recruited through face-to-face contacts, e-mails and Internet advertisements. **Design and setting:** Participants completed a baseline assessment via Internet and were randomly assigned to two conditions (with and without evening SMS). Over four weekends, both Friday and Saturday night, drinking was assessed via SMS questions sent the next day to the participants' cell phones. **Results:** A high retention rate (75% in total) was obtained across all three recruitment conditions. The number of drinks indicated in the SMS survey was strongly correlated with the usual quantity assessed via Internet and did not differ depending on whether an additional SMS question was sent in the evening or not. **Conclusion:** The new method shares some of the advantages of conventional diaries but overcomes most of the limitations: it is easy to use, cost-effective and suitable for large-scale surveys. Application restrictions and further developments are discussed.

INTRODUCTION

There is no ideal way to assess alcohol consumption, since each method has its own specific advantages and disadvantages (Dawson, 1998a). Often, the number of drinking occasions is assessed over longer periods (e.g. 12 months or 30 days) and participants are asked to 'average' the number of standard drinks they consume at a 'typical' or 'usual' drinking occasion. However, such retrospective assessment methods are subject to measurement errors since precise recall of the number of drinking occasions and the number of drinks 'typically' consumed at these occasions declines considerably after 2 or 3 days due to memory deficits (Ekholm, 2004).

This problem can be attenuated by using prospective diaries in which respondents are asked to indicate their consumption shortly after the drinking event (e.g. at the end of the day or early next day: Affleck *et al.*, 1999). This type of assessment usually produces more accurate information about the quantities consumed, especially when multiple drinking occasions are taken into account (Leigh, 2000; Gmel and Rehm, 2004).

Nevertheless, two main disadvantages persist when using diaries. First, daily reports in diaries are expensive and labor intensive, as participants must be first trained and monitored (Bolger *et al.*, 2003). Second, the diary method involves the processing and coding of large quantities of complex data (Hoppe *et al.*, 2000; Bolger *et al.*, 2003). Due to the high response burden associated with diary use, this method is commonly adopted in small-scale studies and over restricted time periods (e.g. 1 or 2 weeks). Longer survey periods have been reported for very selective samples made up of highly motivated participants (Gmel and Rehm, 2004). Thus, conventional diaries have a restricted utility in large-scale longitudinal surveys. Second, while the short recall periods in diaries is an advantage, it nevertheless tends to overestimate both abstainers and frequent drinkers when the diary information is used to project consumption over longer time intervals (e.g. 12 months, Gmel and Rehm, 2004). Hence, the recommendation by researchers

that prospective diaries should be used in combination with retrospective assessment methods (Dawson, 1998b; Gmel and Rehm, 2004).

However, such an approach further increases the burden for both the respondents to complete the retrospective assessment and the diary, and for the researcher to collect and code the information before entering it into an electronic database. This increased burden threatens the viability of such an approach in large-scale surveys, especially when conducted over longer time intervals. Interactive voice response (IVR: Searles *et al.*, 2000; Collins *et al.*, 2003), wireless personal digital assistants (PDA: Bolger *et al.*, 2003; LaBrie *et al.*, 2006; Bernhardt *et al.*, 2007) and the Internet (McCabe *et al.*, 2002; Miller *et al.*, 2002; Kypri *et al.*, 2004; Parks *et al.*, 2006; Kuntsche *et al.*, 2008) offer alternative ways to measure alcohol consumption. There is evidence that IVR, PDA and web-based surveys yield similar results to paper-and-pencil methods, but have the added advantage of lower data entry errors and improved cost-effectiveness (McCabe *et al.*, 2002; Miller *et al.*, 2002; LaBrie *et al.*, 2006; Bernhardt *et al.*, 2007).

To our knowledge, no alcohol research studies to date have used short message service (SMS) technology, a communication service that uses standardized communications protocols to allow the interchange of short text messages between mobile telephone devices. This is surprising given that SMS, since its development in the early 1990s, has become the most widely used mobile data service on earth (Rodgers *et al.*, 2005). In developed countries, ~85–96% of young people own a cell phone (Bramley *et al.*, 2005; Dimonte and Ricchiuto, 2006; Dobkin *et al.*, 2007; Lajunen *et al.*, 2007; Bischof *et al.*, 2008; Kauer *et al.*, 2009); most cell phone owners, particularly young adults, use SMS (Rodgers *et al.*, 2005). Based on answers from >48 000 15-year olds from 31 European and North American countries and regions, Kuntsche and colleagues (in press) found that in 2006, two-thirds of adolescents communicated with their friends via SMS and other electronic devices on a daily or almost daily basis.

In medical treatment and intervention, SMS has been used to deliver smoking cessation advice and support (Obermayer *et al.*, 2004; Rodgers *et al.*, 2005), to encourage the self-management of asthma (Anhoj and Moldrup, 2004), and to improve attendance at outpatient clinic appointments (Downer *et al.*, 2005). Only one study was found in which SMS was used not only to deliver but also to gather information from patients (i.e. concerning their asthma symptoms; see Anhoj and Moldrup, 2004). Despite its potential for alcohol research, no attempt, to our knowledge, has been made to collect data on alcohol consumption using SMS technology.

The aim of the present study is to describe the feasibility, strengths, limitations and problems of assessing alcohol consumption in a convenience sample of young adults using SMS technology in combination with a web-based questionnaire. In particular, the study provides information about participation and retention rates and investigates the correlation between usual and event-specific consumed quantities. To address the problem of possible assessment reactivity (Affleck *et al.*, 1999; Bolger *et al.*, 2003), we investigated whether sending an alcohol-related SMS in the evening changed the number of consumed drinks reported the following day.

METHODS

Participant recruitment

Three strategies were used to recruit young adult participants in the Swiss Riviera, a wine-producing area: (1) face-to-face contact, (2) e-mail and (3) an Internet advertisement. (1) A research assistant went to four introductory courses given at driving schools in Lausanne to present the study and to ask for participation. Driving schools were chosen because they represent a non-alcohol-related environment with a high proportion of individuals in the target age range. (2) E-mail invitations to participate in the study were sent to 404 students of two small Universities of Applied Sciences in the Lausanne area. (3) A description of the study and an invitation were published on the advertisement page of the Lausanne University website and on a private Facebook entry.

In accordance with the Helsinki Declaration (World Medical Association (WMA), 2002), participants in all three recruitment strategies were told about the aim of the study (i.e. to gather information via SMS on their alcohol consumption and related factors over four subsequent weekends), that they could leave any question unanswered, and that their responses would be treated confidentially. They were also instructed that they could send their answers free of charge via SMS. As an incentive, a lottery was organized with two prizes: a movie card that would allow the owner to see six films in any movie theater in Lausanne (value: ~55 Euro) and a railway pass that would allow the holder to travel by train across Switzerland and to visit a large number of museums and other attractions (value of ~40 Euros).

Procedure

Data were gathered via a baseline Internet survey, via SMS questions and via qualitative telephone interviews. These three ways of data collection offer the advantage of allowing us to assess individual-specific and time-invariant characteristics from

a baseline, situation-specific and time-dependent perspective at a given moment in time, and to gain more in-depth information about the strength and problems associated with this new assessment technique.

On the first page of the web-based questionnaire, participants were asked to give their cell phone number. Subsequently, participants received a confirmation code sent via SMS to their cell phones, which gave them individualized access to the online questionnaire. This procedure was chosen to validate the participants' cell phone number, which was then treated confidentially by the electronic system (i.e. not accessible even to the researchers). The Internet questionnaire contained questions on gender, age, drinking motives, drinking frequency in the last 12 months, usual quantity of standard drinks (containing ~12 g of alcohol) consumed at 'typical' drinking occasions and the frequency of having five drinks or more in a row.

In the SMS diary survey, we restrict the data collection to Fridays and Saturdays to minimize the response burden for the participants, which still enables the maximum capture of high-risk drinking that usually occurs on Friday and Saturday nights (Gmel *et al.*, 2005; Kauer *et al.*, 2009). To capture situational and temporal variability in drinking over the weekend, the present study included eight subsequent weekend days (Friday and Saturday). This is in line with the conclusion recently reached by Kauer *et al.* (2009), which states that diary studies should possibly lengthen the study period to include multiple weekends.

To investigate assessment reactivity (Affleck *et al.*, 1999; Bolger *et al.*, 2003), participants in the SMS survey were randomly assigned to two different conditions. In the first condition, participants received an SMS at 9 p.m. on Friday and Saturday, asking them to indicate via SMS what their motive for drinking was, insofar as they were currently drinking or if they intended to do so later that evening. The exact formulation of the SMS question was: 'Pour quelle(s) raison(s) bois-tu ou vas-tu boire ce soir? (Y R U drinking/going 2 drink 2 night?)'. On the next day at 1 p.m., they received an SMS asking about the total number of drinks consumed in the last 24 h (exact SMS formulation: 'Passé une bonne soirée? Merci d ns indiquer le nbre de verres consommés hier soir en inscrivant directement le nbre (Ex: 5 verres)' [Had a good evening last night? Type in no. of drinks you had (e.g. 5 glasses)]). This was followed by a second SMS about the consequences of their alcohol consumption from the previous night (exact SMS formulation: 'Ta consom. d'hier soir a-t-elle eu des conséquences? (e.g.: g la gueule d bois) [Did UR drinking have any effects (e.g. hangover)?]'). Answers could be given in free text format (160 characters), which tends to provide more precise answers than pre-defined formats (Leigh, 2000). The procedure was conducted over four weekends.

Condition 2 was identical to Condition 1 except that participants did not receive an SMS on Friday or Saturday evening. In both conditions, two SMS were sent on the first day of the SMS survey to remind participants of the study and to instruct them on how to send their SMS replies correctly.

In Condition 1, participants had to answer a total of 24 SMS; in Condition 2, there were 16 SMS questions. For this feasibility study, the contract with Tinybee (www.tinybee.net, the company that developed the technical solution for the combined Internet-SMS survey) involved the use of 3000 SMS, including replies; the costs of sending the questions and answers were

Table 1. Means (standard deviation and number of participants in brackets) of the usual number of standard drinks (assessed in the web-based questionnaire) and the number of standard drinks indicated on the following day (assessed by SMS replies)

	Total Sample	Gender		Age		Condition	
		Women	Men	18–22	23–26	1 (with additional SMS)	2 (without)
Usual quantity	3.0 (1.5, 55)	2.8 (1.4, 37)	3.4 (1.6, 18)	2.7 (1.4, 23)	3.3 (1.5, 32)	3.1 (1.5, 30)	2.9 (1.4, 25)
1. Saturday	2.7 (3.0, 54)	2.3 (2.4, 37)	3.6 (4.0, 17)	2.3 (2.9, 23)	3.0 (3.1, 31)	2.8 (2.9, 29)	2.6 (3.2, 25)
1. Sunday	2.9 (3.4, 52)	2.7 (3.1, 35)	3.4 (3.9, 17)	3.5 (3.8, 21)	2.5 (3.1, 31)	3.1 (3.5, 29)	2.7 (3.3, 23)
2. Saturday	2.7 (3.2, 45)	2.9 (3.5, 32)	2.3 (2.4, 13)	2.6 (4.0, 18)	2.8 (2.7, 27)	3.2 (3.7, 23)	2.3 (2.7, 22)
2. Sunday	4.1 (4.5, 50)	3.8 (4.5, 36)	4.8 (4.5, 14)	3.3 (3.5, 19)	4.6 (5.0, 31)	5.3 (4.9, 25)	2.9 (3.7, 25)
3. Saturday	2.8 (3.5, 48)	2.4 (3.3, 34)	3.7 (3.8, 14)	3.1 (3.9, 18)	2.6 (3.2, 30)	3.2 (4.0, 24)	2.4 (2.8, 24)
3. Sunday	4.1 (4.6, 47)	4.1 (4.8, 32)	4.2 (4.3, 15)	3.8 (5.5, 18)	4.3 (4.1, 29)	5.0 (5.1, 24)	3.3 (4.0, 23)
4. Saturday	3.1 (4.3, 46)	3.3 (4.5, 32)	2.8 (4.0, 14)	1.9 (2.6, 17)	3.9 (5.0, 29)	2.9 (3.8, 23)	3.4 (4.8, 23)
4. Sunday	3.2 (3.2, 49)	2.7 (2.7, 33)	4.3 (3.9, 16)	2.2 (2.4, 19)	3.9 (3.5, 30)	3.3 (2.7, 26)	3.1 (3.7, 23)
Weekend average per day	3.2 (3.8, 391)	3.0 (3.7, 271)	3.7 (3.9, 120)	2.8 (3.6, 153)	3.5 (3.8, 238)	3.6 (3.8, 203)	2.8 (3.5, 188)

covered by the system. This meant that on cost grounds, only a maximum of 70 individuals could participate in the survey. As soon as this figure was reached, the designated website was shut down.

To assist with the interpretation of the quantitative results, qualitative interviews with four randomly selected participants (two per condition) were conducted 1 month following the completion of the SMS survey. To gather more information about possible problems with the survey method, two interviews were conducted with participants who quit after completing the web-based questionnaire. To find out more about potential extensions of the assessment method, two interviews were conducted with individuals who participated throughout the entire study.

RESULTS

Participation

The Internet page to register for the survey opened on Tuesday, 15 January 2008, and closed on Monday, 21 January, because the maximum number of registrations (i.e. 70) had been reached. One participant tried to take part twice in the survey. His or her second attempt was deleted from the database. Three subscribers indicated that they drank only once a month or less frequently and gave up after having completed the Internet survey, probably because they felt that this survey did not apply to them. Among the remaining participants, 83.3% (55 out of 66) took part in the SMS-based survey, of which 89.1% (49 out of 55) continued to provide answers until the last day. This corresponds to a total retention rate of 74.2% (49 out of 66). Concerning the recruitment strategies, 5 from face-to-face contact, 30 via e-mail and 31 from the Internet advertisement participated in the study. Of those, 4 (80%) recruited from face-to-face contact, 24 (80%) via e-mail and 21 (66.7%) from the Internet advertisement participated until the end of the survey ($\chi^2 = 1.3$, $df = 2$, n.s.). Of the 33 respondents in Condition 1 (with additional SMS in the evenings), 27 participated until the end (78.8%); in Condition 2, it was 69.7% (i.e. 23 out of 33 participants; $\chi^2 = 0.7$, $df = 1$, n.s.).

The following analyses were based on the 55 French-speaking individuals who answered all questions in the Internet survey and participated in the SMS survey for at least one entire weekend. This sample consisted of 37 women (67.3%);

the mean age of the sample was 22.7 years ($SD = 1.9$). Most participants (84.4%) answered all SMS alcohol use questions or left only one question unanswered.

Means and associations

Since the number of drinks had been reported in free text format via SMS, two independent coders translated the answers into the specific database format. The average κ -values of 0.95 across the alcohol assessments demonstrated a very high concordance between the two coders [κ -values between 0.40 and 0.75 represent a fair to good concordance beyond chance, while values >0.75 express excellent concordance (Fleiss *et al.*, 2003)].

On average, the 55 participants reported 3.0 drinks at a 'typical' drinking occasion (Table 1). This quantity was higher among men than that among women, and higher among older participants than that among younger ones. It was also higher for Condition 1 than that for Condition 2. However, the differences were not statistically significant ($t_{\text{gender}} = 1.36$, $t_{\text{age}} = 1.51$, $t_{\text{condition}} = 0.6$). Across the eight weekends (both Friday and Saturday) of the SMS survey, between 45 and 54 participants provided indications of their alcohol consumption (391 indications in total). Averaged over the weekend, participants reported a mean of 3.2 drinks. Across weekend days, considerable variations were found ($SD = 3.8$; skewness = 1.5).

To determine differences in weekend alcohol use according to gender, age and participation conditions (i.e. with and without an additional SMS in the evenings), we applied multilevel modeling in HLM 6.02 (Raudenbush *et al.*, 2004) to account for the nested structure of the data, i.e. eight weekend days for 55 individuals ($N = 391$). Robust standard errors were used to account for the skewness of the alcohol use outcome (Raudenbush and Bryk, 2002). Men ($B = 0.42$; $SE = 0.54$), older participants ($B = 0.24$; $SE = 0.12$) and those in Condition 1 ($B = 0.72$; $SE = 0.58$) reported more drinks across the weekend days. The effect was significant for age ($t = 2.0$; $P < 0.05$) but not for gender ($t = 0.8$; n.s.) or participation conditions ($t = 1.3$; n.s.).

The usual quantity indicated in the Internet baseline survey was positively correlated with the number of drinks indicated in the SMS-based survey (Table 2). The correlation was not significant for the first three SMS measurements. The number of drinks indicated in the SMS-based survey was not always positively correlated across the 8 days of the survey. This was

Table 2. Bivariate Pearson correlation of the alcohol use variables used in the study

	Usual quantity	1.	2.	3.	4.	5.	6.	7.
Average ^a	0.57***							
1. 1. Saturday	0.12							
2. 1. Sunday	0.20	-0.09						
3. 2. Saturday	0.19	0.18	0.19					
4. 2. Sunday	0.50***	0.17	0.21	0.25				
5. 3. Saturday	0.51***	0.09	0.22	0.45**	0.31*			
6. 3. Sunday	0.33*	0.05	0.23	0.53***	0.31*	0.32*		
7. 4. Saturday	0.46**	0.20	-0.04	0.05	0.31*	0.33*	0.26†	
8. 4. Sunday	0.49***	0.07	-0.02	0.26†	0.42**	0.22	0.34*	0.29†

^aScore across the 8 weekend days aggregated at the individual level; † $P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

particularly the case for the first weekend. In the second, third and fourth weekends, the correlation across the measurements was mostly between 0.30 and 0.40.

DISCUSSION

The aim of the present study was to test the feasibility of measuring alcohol consumption using a web-based questionnaire combined with questions sent to the participants' cell phones via SMS. One concern was that it might be difficult to find participants due to the fact that they would have to supply their cell phone number, information which they might consider private or did not want to give for fear of receiving spam-SMS (Anhoj and Moldrup, 2004). However, these concerns were unfounded since we had to close the registration page after only 6 days because the maximum number of participants had been reached. In addition, once registered online, >80% participated in the SMS part of the survey and nearly 75% participated until the end of the entire study; these retention rates are similar to conventional diary studies (Leigh, 2000). In the interviews conducted 1 month after the SMS survey, the participants indicated that they had taken part because they found the research subject important and the incentives attractive. As previously observed in other web-based surveys, using incentives resulted in high response rates (Kypri *et al.*, 2004; Parks *et al.*, 2006). During the interviews, participants stated their willingness to reply to SMS questions even over a longer time interval.

Another concern was that face-to-face contact rather than an e-mail or online advertisements would be necessary to explain the study procedure fully. If this proved to be the case, it would cast doubt on the viability of this method for larger samples (cf also Bolger *et al.*, 2003). However, the results showed that the share of those who participated until the end of the SMS-based survey remained the same regardless of whether they were recruited via face-to-face contact or e-mail (both 80%). Only for those who were recruited via Internet advertisements was this share slightly lower (67%). Moreover, during the interviews, all participants reported that they had had no problem understanding the instructions provided in the Internet advertisements and in the e-mails. One participant even mentioned that the reminder and the instruction SMS sent on the first day were unnecessary. Thus, it would appear that the method is indeed suitable for use in large-scale surveys. In an earlier web-based survey, for example, we recruited participants by

using a list of >8000 e-mail addresses that students received when they enrolled at the university (Kuntsche *et al.*, 2008).

Compared to the online assessment of usual quantity, the SMS-based assessment found a high variation in daily quantity. Scrutinizing individual variations over time revealed that some participants abstained from drinking when they had consumed large quantities the day before. This highlights the importance of future studies on the daily processes responsible for variations in individual drinking over time (Affleck *et al.*, 1999; Mohr *et al.*, 2005). In general, however, there was a good match between the different SMS measurements and the usual quantity indicated in the Internet questionnaire. This is consistent with comparisons of conventional diaries and retrospective questionnaires (Leigh, 2000).

One exception was the number of consumed drinks indicated over the 2 days of the first weekend. These were lower than and uncorrelated not only with the Internet assessment of usual quantity but also with the SMS assessment provided over subsequent weekends. It might be that, during the first weekend (i.e. the start of the survey), participants monitored their drinking more closely, perhaps due to a heightened awareness that they were taking part in a scientific study (Affleck *et al.*, 1999). However, this reactivity seemed to diminish from the second weekend onward, since the SMS-reported quantities matched the baseline assessment more closely in terms of both means and correlations.

Although it is common in diary studies for the reactivity observed at the beginning of a survey to dissipate 1 or 2 days later (Bolger *et al.*, 2003), no major assessment reactivity was observed when a SMS question was sent at 9 p.m., i.e. prior to or during a possible drinking event. This is borne out by the fact that no substantial change in the reported number of drinks was found between the two conditions. Although the average number of drinks reported via SMS was slightly higher with an evening SMS than that without, participants in the first condition also reported a higher usual quantity at baseline than those assigned to the second condition.

This pilot study has several limitations. First, we used a convenience sample in which the number of participants had to be restricted to 70 due to cost constraints (the final sample consisted of 55 participants). Although this resulted in 391 observations (7.1 indications per participant on average), there is still the possibility of sample selection bias. Therefore, means and associations have to be interpreted with caution. Second, due to the recruitment strategies used, it was not possible to calculate response rates for the present study. As an alternative, we measured the time taken to reach the maximum number of participants and calculated the retention rate, which proved to be high.

CONCLUSION

Advantages of the combined Internet and SMS technology to assess alcohol consumption

The combination of an Internet- and SMS-based survey, as tested in the present study, shares some of the advantages of conventional diary studies, namely minimizing recall bias and thereby producing more precise information about consumed quantities (Leigh, 2000; Gmel and Rehm, 2004). In addition,

the assessment of multiple drinking occasions over time also enables the capture of variations in the amount consumed across drinking occasions.

Like other electronic assessment methods (IVR, PDA, Internet), the Internet-SMS survey method has a number of additional advantages over conventional diaries.

1. The use of the Internet and SMS for survey purposes is neither costly nor labor intensive (Anhoj and Moldrup, 2004; Bischof *et al.*, 2008). In fact, the presented survey method is much cheaper than telephone interviews or paper-pencil diaries. The system developed by the company Tinybee was easy to use; the entire fieldwork was performed by a research assistant who required no special training.
2. A comparison of the recruitment methods demonstrated that face-to-face contact was unnecessary. Apparently, a simple instruction given in an e-mail or via an Internet advertisement was sufficient for the participants to complete the study successfully.
3. Receiving a SMS question is also a way of prompting participants to answer; these prompts are particularly important in diary studies (Bolger *et al.*, 2003). Moreover, the investigator can check whether the answers are given in a reasonably short time interval since the time difference from sending the SMS question to receiving the SMS answer can be tracked. For example, in conventional diaries, participants could possibly fill out the entire diary in one sitting rather than on a day-by-day basis (Leigh, 2000; Bolger *et al.*, 2003).
4. At any time during the study, the progression of data collection can be checked by the investigators; this is normally not possible with the conventional diary method (Leigh, 2000). Moreover, at the end of the study, all data can be readily downloaded in a standard database format. No data entry is necessary. All that is required is data editing to convert the free-format answers into the database format (e.g. '7 drinks' indicated in the SMS relates to '7' in the database).
5. By using the information obtained in the Internet survey, it is possible to capture infrequent drinking events, which tend to be biased when information from diaries alone is used (Gmel and Rehm, 2004).

The assessment of alcohol consumption via SMS offers decidedly more advantages than those that are conducted via Internet, PDA or IVR.

1. Most young people in developed countries are very familiar with the technology; they own a cell phone (Bramley *et al.*, 2005; Dimonte and Ricchiuto, 2006; Dobkin *et al.*, 2007; Lajunen *et al.*, 2007; Bischof *et al.*, 2008) and use SMS and other forms of electronic communication on a daily basis (Kuntsche *et al.*, in press). Unlike the use of PDAs that tend to be more labor intensive in terms of malfunction troubleshooting, battery replacement, data uploading, etc. (Armeli *et al.*, 2005), the participants do not have to be provided with and trained in the use of a particular device (Bolger *et al.*, 2003).
2. The SMS questions can be sent and answered at any moment (unlike web-based surveys that require Internet access). Once the participants receive an SMS, they are able to answer free of charge (i.e. the costs for receiving and

sending SMS were covered by the project) and at their own convenience (i.e. at any time and anywhere). This is usually not possible with the IVR method or when using the Internet (Bolger *et al.*, 2003; Armeli *et al.*, 2005).

3. Sending and receiving SMS questions is cheaper than the acquisition of PDAs or conducting IVR via cell phones, for which the costs per minute are usually much higher than those for landline telephones.
4. The inter-individual information obtained from the baseline Internet survey can be used to explain intra-individual associations across the situational assessments, e.g. by means of multilevel modeling.

Disadvantages and new developments

The study population is restricted to cell phone users. The proportion of cell phone owners is high in developed countries (~85–96%; see Bramley *et al.*, 2005; Dimonte and Ricchiuto, 2006; Dobkin *et al.*, 2007; Lajunen *et al.*, 2007; Bischof *et al.*, 2008); in some instances, it outstrips that of fixed-line telephones (Rodgers *et al.*, 2005). In countries with a low proportion of cell phone users, the presented method might be less appropriate. The same applies to particular subgroups, like children or the elderly, who are less familiar with the technology and might have problems understanding the procedure or show reactivity. However, a British study demonstrated that in 2003, nearly half of 10- to 11-year olds owned a cell phone (Davie *et al.*, 2004). In the same year, a Danish study received a good response rate in a sample of 13- to 57-year olds (Anhoj and Moldrup, 2004). Nevertheless, more research is needed to test the appropriateness of the method and possible assessment reactivity in other countries and in particular sub- or high-risk populations, such as North American college students.

The length of one SMS is restricted to 160 characters, i.e. only short answers can be given. This is sufficient for the indication of the consumed number of standard drinks or a short description of alcohol-related consequences, as was the case in the present study. However, an assessment of the specific details surrounding the drinking situation (location, presence of friends, daily moods, alcohol availability, noise level, etc.) would mean a considerable increase in the response burden. Thanks to Universal Mobile Telecommunications System (UMTS), a new generation of cell phones will be able to offer access to the Internet and other data services. With this technology, participants would be able to respond to a web-based survey at any given time and location via their cell phone. Unfortunately, the use of this technology is still not widespread and remains rather expensive.

Acknowledgements — This feasibility study was funded by the Swiss Institute for the Prevention of Alcohol and Drug Problems (SIPA). The authors like to thank the company Tinybee (Samuel Bulliard, Madeleine von Fischer, Natascha Frioud and Valentin Vago) for their technical support and Kyp Kypri, Etienne Maffli and Matthias Wicki for their comments on a previous version of the paper.

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